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06/04

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SECTION 03331

LIGHTWEIGHT ARCHITECTURAL CONCRETE
06/04

NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers lightweight noninsulating concrete floor or roof fill placed over previously installed concrete slabs or other permanent form system.

Drawings must include a complete design indicating the character of the work to be performed and giving the permanent form system, location of lightweight concrete fill, concrete fill thickness, finished floor and roof elevations and slopes as required, location of drains, and sufficient dimensions to convey adequately the quantity and nature of the work.

Normal weight concrete is specified in Section 03305 CAST-IN-PLACE CONCRETE (SHORT SECTION).

Precast concrete decking including cast-in-place concrete fill for curb cants, drainage saddles, and other sloping surfaces is specified in Section 03435 PRECAST CONCRETE DECK.

Metal floor decking and permanent metal forms to receive concrete fills are specified in Section 05311 STEEL FLOOR DECK and Section 03131 PERMANENT STEEL FORMS.

Fire-resistance-rated floor or roof constructions using lightweight, concrete fills are described in Underwriters Laboratories, Inc., "Fire Resistance Ratings (BXUV)" included in UL FRD and "Fire-Resistance Ratings," contained in AIA CO-1. Fire-resistance-rated construction limits the type of permanent form system; the type of lightweight aggregate and proportions of lightweight concrete mix; ceiling construction; and floor or roof construction.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be
manually edited except to add new references.
References not used in the text will automatically
be deleted from this section of the project
specification.

The publications listed below form a part of this section to the extent
referenced:

ACI INTERNATIONAL (ACI)

ACI 211.1	(1997) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 306R	(1988) Cold Weather Concreting
ACI 503.2	(1992) Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 182	(1991; R 2000) Burlap Cloth Made from Jute or Kenaf
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ASTM INTERNATIONAL (ASTM)

ASTM C 109/C 109M	(2002) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C 114	(2004) Standard Test Method for Chemical Analysis of Hydraulic Cement
ASTM C 115	(1996a; R 2003) Standard Test Method for Fineness of Portland Cement by the Turbidimeter
ASTM C 127	(2001) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 136	(2001) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 138/C 138M	(2001a) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete

ASTM C 143/C 143M	(2003) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150	(2002ae1) Standard Specification for Portland Cement
ASTM C 151	(2000) Standard Test Method for Autoclave Expansion of Portland Cement
ASTM C 157/C 157M	(2003) Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar, and Concrete
ASTM C 171	(2003) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(1999) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2001e1) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 183	(2002) Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
ASTM C 185	(2002) Standard Test Method for Air Content of Hydraulic Cement Mortar
ASTM C 191	(2004) Standard Test Method for Time of Setting Hydraulic Cement by Vicat Needle
ASTM C 192/C 192M	(2002) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 204	(2000) Standard Test Method for Fineness of Hydraulic Cement by Air Permeability Apparatus
ASTM C 232	(1999) Standard Test Methods for Bleeding of Concrete
ASTM C 233	(2001) Standard Test Method for Air-Entraining Admixtures for Concrete
ASTM C 260	(2001) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 29/C 29M	(1997) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 31	(2000e1) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 330	(2004) Standard Specification for Lightweight Aggregates for Structural

Concrete

ASTM C 332	(1999) Standard Specification for Lightweight Aggregates for Insulating Concrete
ASTM C 39/C 39M	(2003) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 403/C 403M	(1999) Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C 451	(2004) Standard Test Method for Early Stiffening of Hydraulic Cement (Paste Method)
ASTM C 566	(1997; R 2004) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 595	(2003) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2003) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 94/C 94M	(2003a) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2004) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 75	(2003) Standard Practice for Sampling Aggregates

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Records of qualification shall be submitted in accordance with the

paragraphs entitled, "Qualifications for Concrete Testing Service" and "Qualifications for Ready-Mix Concrete Manufacturer," of this section.

SD-05 Design Data

Mix design data for Lightweight Concrete shall be submitted 15 calendar days prior to start of specified work.

SD-06 Test Reports

Test reports for Compressive Strength of Concrete shall be in accordance with the paragraph entitled, "Sampling and Testing," of this section.

SD-07 Certificates

Certificates of compliance for concrete shall contain project name and number, date, name of Contractor, name of concrete testing service, concrete class, manufacturer and brand name for each material, the exact proportions of concrete mix, properties specified for lightweight concrete and test results for each requirement specified for design mix.

Aggregates
Portland Cement
Lightweight Concrete

1.3 DEFINITION OF LIGHTWEIGHT CONCRETE FILL

Lightweight concrete fill shall mean concrete having a 28-day, air-dry weight of not less than 70 1120 nor more than 100 pounds per cubic foot (pcf) 1600 kilogram per cubic meter.

1.4 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Concrete sampling and testing shall be performed by a laboratory and inspection service experienced in sampling and testing lightweight concrete.

1.5 QUALIFICATIONS FOR READY-MIX CONCRETE MANUFACTURER

Concrete shall be manufactured and delivered to the project site by a ready-mix concrete manufacturer experienced in ready-mix lightweight concrete.

PART 2 PRODUCTS

2.1 LIGHTWEIGHT CONCRETE MATERIALS

NOTE: When fire-resistance-rated construction is required, consult fire-rating agency's design and material requirements for the applicable floor construction.

Aggregates shall be fine and coarse lightweight aggregates conforming to ASTM C 332, Group II, or ASTM C 330.

[Portland Cement shall conform to ASTM C 150, Type I.]

[Blended hydraulic cement shall conform to ASTM C 595, Type [____].]

One brand and type of cement shall be used for formed concrete having exposed-to-view finished surfaces.

Air-entraining admixture shall conform to ASTM C 260.

Water for mixing concrete shall be potable.

Fly ash [is required] [used] as an admixture [and] shall conform to ASTM C 618, Class [C or F] with 4 percent maximum loss on ignition and between 15 to 35 percent maximum cement replacement by weight.

NOTE: Ground granulated blast furnace slag is one of the materials listed in the EPA's Comprehensive Procurement Guidelines (CPG) (<http://www.epa.gov/cpg/>). If the Architect/Engineer determines that use of certain materials meeting the CPG content standards and guidelines would result in inadequate competition, do not meet quality/ performance specifications, are available at an unreasonable price or are not available within a reasonable time frame, the Architect/Engineer may submit written justification and supporting documentation for not procuring designated items containing recovered material. Written justification may be submitted on a Request for Waiver Form to the NASA Environmental Program Manager for approval. The Request for Waiver Form is located in the NASA Procedures and Guidelines (NPG 8830.1) (<http://nodis3.gsfc.nasa.gov>).

Ground granulated blast furnace slag [is required] [used] as an admixture [and] shall conform to ASTM C 989, Grade [120] with between 25 to 50 percent maximum cement replacement by weight.

Ready-mix Lightweight Concrete shall meet the requirements of ASTM C 94/C 94M with the following modifications:

ASTM Section 5, entitled, "Ordering Information;" delete subsections 5.1.4 and 5.1.5 and substitute the following: Lightweight concrete materials, design mix, and quality of concrete shall be as specified in the project specifications.

ASTM Section 6, entitled, "Tolerances in Slump;" delete subsections 6.1.1 and 6.1.2 and substitute the following: Slump shall not be more than the value specified for lightweight concrete in the project specifications.

ASTM Section 11, subsection entitled, "Central-Mixed Concrete;" delete reference to nonagitating equipment. Use of nonagitating equipment will not be permitted.

ASTM Section 11, subsection 11.7; delete section and substitute the following: When a truck mixer or agitator is used for mixing or

delivery of concrete, no water from the truck-water system or elsewhere shall be added after initial introduction of the mixing water for the batch. Concrete shall be delivered to site of work and discharge shall be completed within 1-1/2 hours or before drum has turned 300 revolutions, whichever comes first, after introduction of mixing water to cement and aggregates or cement to the aggregates, except that in hot weather, when temperature of concrete is 85 degrees F 30 degrees C and above, the 1-1/2-hour mixing and delivery time shall be reduced to 45 minutes. When a truck mixer is used for complete mixing of concrete, the mixing operation shall begin within 30 minutes after cement has been intermingled with the aggregates.

ASTM Section 11, subsection entitled, "Mixing and Delivery;" add the following paragraphs and subparagraphs:

Concrete made with lightweight aggregates that have 10 percent or less total absorption by weight before predampening, as determined by ASTM C 127 or are low absorptive with less than 2 percent additional absorption in the first hour, or can be made low absorptive by predampening, shall be mixed and batched as specified.

Concrete made with lightweight aggregates that have more than 10 percent total absorption shall be batched and mixed as follows:

Air-entraining admixture and entire weight of predampened aggregates shall be added to approximately 80 percent of mixing water and mixed for a minimum of 1/2 minute. When aggregates have not been predampened, air-entraining admixture shall not be added until aggregate and water have been mixed a minimum of 1-1/2 minutes.

Entire weight of cement and withheld portion of mixing water shall be added, in that order, and mixing completed as specified.

Immediately prior to discharge of concrete made with lightweight aggregates, the mixer shall be rotated 1/2 minute, or approximately 10 revolutions, at mixing speed to minimize segregation.

ASTM Section 16, entitled, "Batch Ticket Information;" add the following: With each load of concrete delivered to project site, the ready mixed concrete manufacturer shall furnish duplicate delivery tickets. In addition to requirements of ASTM Section 16, delivery tickets shall provide the following information:

Type and brand of cement

Cement content in 94-pound 43 kilogram bags per cubic yard 0.75 cubic meter of concrete

Type and brand name of lightweight aggregates

Maximum size of lightweight aggregate

Amount and brand name of air-entraining admixture

Unit weight of fresh concrete in pounds cubic foot (pcf) kilogram per cubic meter

ASTM Section 17, entitled, "Strength;" delete text and substitute the following: Contractor shall provide concrete testing service

as specified in project specifications.

2.2 CONCRETE CURING MATERIALS

Absorptive cover for curing concrete shall be burlap cloth made from jute or kenaf, conforming to AASHTO M 182, Class 3.

Moisture-retaining cover for curing concrete shall be regular waterproof paper, white, opaque polyethylene film, or white burlap-polyethylene sheet conforming to ASTM C 171.

Water for curing concrete shall be potable.

2.3 QUALITY OF CONCRETE

2.3.1 General

Proportion of concrete ingredients shall be selected to produce a homogeneous, workable concrete when using methods of mixing, placing, and finishing specified herein, and shall have the compressive strength and other properties specified.

2.3.2 Lightweight Concrete Properties

Lightweight concrete shall consist of portland cement, water, and lightweight coarse and fine aggregates without admixtures or aeration except air-entraining admixture, and shall have the following properties:

<u>PROPERTY</u>	<u>VALUE</u>
Design compressive strength at 28 calendar days	Not less than 2,000 psi
Maximum aggregate size	3/8 inch
Slump at point of concrete discharge	Not more than 3 inches
Total air content by volume at point of concrete discharge	Not less than 6 nor more than 10 percent
Air-dry density at 28 calendar days	Not less than 70 nor more than 100 pcf

<u>PROPERTY</u>	<u>VALUE</u>
Design compressive strength at 28 calendar days	Not less than 13.8 Megapascal
Maximum aggregate size	9.5 millimeter
Slump at point of concrete discharge	Not more than 9.5 millimeter
Total air content by volume at point of concrete discharge	Not less than 6 nor more than 10 percent
Air-dry density at 28 calendar days	Not less than 1120 nor more than 1600 kilogram

PROPERTY

VALUE
per cubic meter

PART 3 EXECUTION

3.1 SAMPLING AND TESTING

3.1.1 Concrete Testing Service

Testing service from an approved testing organization shall be provided by the Contractor.

Testing by the Contractor shall include sampling and testing lightweight concrete materials proposed for use in the work and the design mix for lightweight concrete. Quality control testing during construction will be by the [Government.] [Contractor.]

3.1.2 Tests for Lightweight Concrete Materials

NOTE: Delete paragraph heading and the following paragraphs when certificates of compliance are required instead of laboratory tests. Laboratory tests are recommended when the quantity of concrete exceeds 1,200 cubic yards 920 cubic meter.

Lightweight concrete materials proposed for use in the work shall be sampled and tested to determine conformance to referenced specifications as follows:

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Lightweight aggregate	Sampling	ASTM D 75 ASTM C 332	One for each material
	Grading	ASTM C 136 and ASTM C 332	
	Unit weight (loose)	ASTM C 29/C 29M and ASTM C 332	
Lightweight concrete using proposed aggregates	Specimen preparation	ASTM C 192/C 192M and ASTM C 330	Three specimens for each type of test to determine concrete making properties of proposed lightweight aggregates
	Compressive strength	ASTM C 39/C 39M	
	Shrinkage	ASTM C 157/C 157M and ASTM C 330	
Lightweight concrete	Materials for tests	ASTM C 233	As required for each type of

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
using proposed air-entrain- ing mixture	Number of specimens	ASTM C 233 Table 1	test to deter- mine performance of air-entrain- ing admixtures
	Bleeding	ASTM C 232	
	Time of setting	ASTM C 403/C 403M and ASTM C 233	
	Compressive strength test specimen	ASTM C 192/C 192M and ASTM C 233	
Portland cement	Compressive strength test at 3, 7, and 28 calendar days	ASTM C 39/C 39M and ASTM C 233	As required for each type of test to deter- mine conformance of portland cement
	Sampling	ASTM C 183	
	Chemical analysis	ASTM C 114	
	Fineness	ASTM C 115 or ASTM C 204	
	Autoclave expansion	ASTM C 151	
	Time of setting	ASTM C 191	
	Air content of mortar	ASTM C 185	
	Compressive strength False set	ASTM C 109/C 109M ASTM C 451	

A report in writing for each material sampled and tested shall be submitted for approval prior to start of specified work. Reports shall contain the project name and number, date, name of Contractor, name of concrete testing service, material manufacturer and brand name, material name, values specified in referenced specification for each material, and test results.

3.1.3 Design Mix for Lightweight Concrete

Design mix for lightweight concrete using portland cement, lightweight aggregates, and air-entraining admixture previously approved for use in the work shall be determined and tested as follows:

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Dry loose unit	ASTM C 29/C 29M	

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
weight of aggregates	and ASTM C 332	
Moisture contents of aggregates	ASTM C 566	
Trial mixes using at least three different cement factors with air entrainment and maximum allowable slump	ACI 211.1	As required to derive the concrete mix having properties specified for light-weight, noninsulating concrete in article entitled, "Quality of Concrete"
Making and curing concrete specimens in laboratory	ASTM C 192/C 192M	Two sets of four specimens for each design mix
Sampling fresh concrete in laboratory	ASTM C 192/C 192M	One for each set of design mix specimens
Slump	ASTM C 143/C 143M	
Air content	ASTM C 173/C 173M	
Yield	ASTM C 138/C 138M	
Compressive strength	ASTM C 39/C 39M	Three specimens tested at 7 calendar days and three specimens tested at 28 days
Air-dried unit weight	ASTM C 330	After curing

3.1.4 Quality Control Testing During Construction

Lightweight concrete will be sampled and tested for quality control by the [Government] [Contractor] during placement of concrete as follows:

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Sampling fresh concrete	ASTM C 172 except modified for slump per ASTM C 94/C 94M	As required for each test
Slump test and unit weight of fresh concrete	ASTM C 143/C 143M ASTM C 138/C 138M	One for each concrete load at point of discharge; one for each set of compressive strength tests
Air content by volumetric method	ASTM C 173/C 173M	One for each set of compressive strength

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
		tests
Compressive test specimens	ASTM C 31	One set of four standard cylinders for each compressive strength test
Concrete temperature		Hourly when air temperature is 40 degrees F or below and each time a set of compression test specimens is made
Compressive strength tests	ASTM C 39/C 39M	One for each 150 cubic yards or fraction thereof of concrete placed in any one day; three specimens tested at 28 calendar days, and one specimen retained in reserve for testing if required
Air-dried unit weight at 28 calendar days	ASTM C 39/C 39M	One for each compressive strength test

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Sampling fresh concrete	ASTM C 172 except modified for slump per ASTM C 94/C 94M	As required for each test
Slump test and unit weight of fresh concrete	ASTM C 143/C 143M ASTM C 138/C 138M	One for each concrete load at point of discharge; one for each set of compressive strength tests
Air content by volumetric method	ASTM C 173/C 173M	One for each set of compressive strength tests
Compressive test specimens	ASTM C 31	One set of four standard cylinders for each compressive strength test
Concrete temperature		Hourly when air temperature is

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
		5 degrees C or below and each time a set of compression test specimens is made
Compressive strength tests	ASTM C 39/C 39M	One for each 115 cubic meter or fraction thereof of concrete placed in any one day; three specimens tested at 28 calendar days, and one specimen retained in reserve for testing if required
Air-dried unit weight at 28 calendar days	ASTM C 39/C 39M	One for each compressive strength test

3.2 PREPARATION BEFORE CONCRETE PLACING

3.2.1 General

Surface to receive lightweight concrete fill shall receive [1/4-inch 6 millimeter roughening] [one coat of bonding agent per ACI 503.2].

Surfaces to receive lightweight concrete fill shall be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

3.2.2 Permanent Metal Forms for Concrete

Forms for concrete, including reinforcement and other embedded items, shall be completed, inspected, and approved prior to start of concrete placing.

3.2.3 Edge Forms and Screed Strips

Edge forms and intermediate screed strips shall be set accurately to obtain indicated elevations and contours in finished lightweight concrete fill surface and shall be sufficiently strong to support vibrating bridge screeds or roller pipe screeds if nature of specified finish requires use of such equipment. Concrete surface shall be aligned to elevations of screed strips by use of strike-off templates or approved compacting-type screeds.

3.3 CONCRETE CONVEYING

3.3.1 Transfer of Concrete at Site

Concrete shall be handled from point of delivery and transfer to concrete conveying equipment and to locations of final deposit as rapidly as practical by methods that will prevent segregation and loss of concrete mix materials.

3.3.2 Mechanical Equipment for Conveying Concrete

Equipment for conveying concrete shall ensure a continuous flow of concrete at delivery end and shall be approved. Runways for wheeled concrete-conveying equipment shall be provided from concrete delivery point to locations of final deposit. Inner surfaces of concrete-conveying equipment shall be maintained free of hardened concrete, debris, water, snow, ice, and other deleterious materials.

3.4 CONCRETE PLACING AND FINISHING

3.4.1 Weather Limitations and Protection

Concrete shall not be placed when temperature of the atmosphere is below 40 degrees F 5 degrees C, nor during rain, sleet, or snow unless protection is provided.

Protection during cold weather shall be as specified.

Protection during inclement weather shall be watertight to prevent entry of rain, sleet, or snow onto surfaces to receive concrete and into fresh concrete.

Protection materials shall be stored at site for use in event of unforeseen weather changes after start of concrete-placing operations.

3.4.2 Depositing

Concrete shall be placed continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness within the section. Concrete placing shall be performed at such a rate that concrete being integrated with fresh concrete is still plastic. Concrete shall be deposited near its final position to avoid segregation due to rehandling or flowing. Concrete shall not be subjected to any procedure that will cause segregation.

Concrete that becomes nonplastic and unworkable, that does not meet the quality control limits specified, or that which has been contaminated by foreign materials shall not be used in the work. Use of retempered concrete will not be permitted. Rejected concrete shall be removed from site and disposed as approved.

Lightweight concrete shall be placed and consolidated in a continuous operation until the placing of a panel or section is completed. During concrete placing operations, concrete shall be consolidated by vibrating bridge screeds, roller pipe screeds, or other approved method so that concrete is worked around embedded items and into corners. Consolidation operations shall be limited to time necessary to obtain consolidation of concrete without bringing an excess of lightweight coarse aggregate to the surface. Concrete to be consolidated shall be as dry as possible and surfaces shall not be manipulated prior to finishing operations. Concrete shall be brought to correct level with a straightedge and struck off. Bull floats or darbies shall be used to smooth surface. Sprinkling of water on plastic surface will not be permitted.

3.4.3 Float Finish

After concrete has been placed, struck off, consolidated, and leveled it

shall not be worked further until ready for floating. Floating shall begin when water sheen has disappeared or when concrete mix has stiffened sufficiently to permit proper operation of a power-driven float or when both conditions have occurred. Surface shall then be consolidated with power-driven floats. Hand floating shall be used in locations inaccessible to power-driven floats. Magnesium, aluminum, or other approved finishing tools suitable for finishing lightweight concrete shall be used. Surface shall be plane to a tolerance not exceeding 1/4 inch in 10 feet 7 in 3000 millimeter when tested with a 10-foot 3000 millimeter straightedge placed on the surface at not less than 2 different angles. High spots shall be cut down and low spots shall be filled. Surfaces shall be uniformly sloped to drains. Immediately after completion of leveling, surface shall be refloated to a uniform, smooth, granular texture.

3.4.4 Trowel Finish

After completion of float finish as specified, the surface shall receive a trowel finish. Magnesium, aluminum, or other approved finishing tools suitable for finishing lightweight concrete shall be used. First troweling after completion of floated finish shall be done by a power trowel and shall produce a smooth surface that is relatively free of defects but which may contain some trowel marks. Additional troweling shall be done by hand after surface has hardened sufficiently. Final troweling shall be started when a ringing sound is produced as the trowel is moved over the surface. Surface shall be consolidated by hand troweling operation. Finished surface shall be free of trowel marks, uniform in texture and appearance, and shall be plane to a tolerance not exceeding 1/8 inch in 10 feet 3 in 3000 millimeter when tested with a 10-foot 3000 millimeter straightedge placed anywhere on the surface in any direction. Surface defects of sufficient magnitude to show through the floor covering shall be removed by grinding.

3.5 CONCRETE CURING AND PROTECTION

3.5.1 General

Freshly placed concrete shall be protected from premature drying and cold or hot temperatures, and shall be maintained without drying at a relatively constant temperature for period of time necessary for hydration of cement and proper hardening of concrete.

Initial curing shall immediately follow concrete finishing operation. Concrete shall be kept continuously moist for not less than 72 hours.

Final curing shall immediately follow initial curing and before the concrete has dried. Final curing shall continue until cumulative number of hours or fractions thereof (not necessarily consecutive) during which temperature of air in contact with concrete above 50 degrees F 10 degrees C has totaled 168 hours. Rapid drying at end of final curing period shall be prevented.

3.5.2 Curing Methods

Initial curing shall be accomplished by covering concrete surface with specified absorptive cover and keeping absorptive cover wet by water spraying or intermittent hosing. Absorptive cover shall be placed so as to provide coverage for concrete surfaces and edges with a slight overlap over adjacent absorptive covers. Final curing, unless otherwise specified, shall be accomplished by continuing the method used for initial curing or

by covering the concrete surfaces with the specified moisture-retaining cover. Moisture-retaining cover shall be placed directly on concrete in the widest practical widths with sides and ends lapped at least 3 inches 75 millimeter and sealed continuously with waterproof adhesive or pressure-sensitive, waterproof tape. Cover shall be weighted to prevent displacement; tears or holes appearing during the curing period shall be immediately repaired by patching with pressure-sensitive, waterproof tape or other approved method.

[Final curing of concrete surfaces to receive floor covering or roofing shall be accomplished by moisture-retaining cover curing.]

3.5.3 Temperature of Concrete During Curing

When temperature of the atmosphere is 40 degrees F 5 degrees C and below, temperature of concrete shall be maintained at not less than 50 degrees F 10 degrees C continuously throughout the concrete curing period. When necessary, arrangements shall be made before the start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature/moisture conditions continuously for the concrete curing period. Cold weather protection shall meet requirements of ACI 306R.

When temperature of the atmosphere is 80 degrees F 27 degrees C and above or during other climatic conditions that will cause too rapid drying of concrete, arrangements shall be made before start of concrete placing for installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of a light color as required to protect the concrete continuously for the concrete curing period. Hot weather protection shall meet requirements of ACI 305R.

Changes in temperature of concrete shall be as uniform as possible and shall not exceed 5 degrees F 3 degrees C in 1 hour nor 50 degrees F 10 degrees C in 24-hour period.

3.5.4 Protection from Mechanical Injury

During curing period, concrete shall be protected from damaging mechanical disturbances (particularly load stresses, heavy shock, and excessive vibration), and from damage caused by rain or running water.

3.5.5 Cleaning Roof Fill Surfaces

[Upon completion of curing, roof fill surfaces shall be swept clean of debris and other foreign matter and left ready to receive roofing.]

3.5.6 Protection After Curing

[Finished floor fill surfaces shall be protected from damage by construction operations until completion of installation of floor covering.]

[Finished roof fill surfaces shall be protected from damage by weather and construction operations until completion of installation of roofing.]

3.6 INSPECTION AND ACCEPTANCE PROVISIONS

3.6.1 Evaluation of Quality Control Test Results

Quality control tests specified will be evaluated as specified.

Lightweight concrete delivered to the point of final placement having a unit weight of fresh concrete which varies more than 2 percent from the design mix wet unit weight or having a slump exceeding the value specified shall not be used in the work.

Compressive Strength of Concrete tests will be considered satisfactory if the average of any group of five consecutive compressive strength tests selected is in each instance equal to or greater than the 28-day design compressive strength of the class of concrete and if not more than one compressive strength test in 10 has a value less than 90 percent of the 28-day design compressive strength.

If compressive strength tests fail to meet the minimum requirements specified, concrete represented by such tests will be rejected and shall be replaced with acceptable concrete at no additional cost to the Government.

3.6.2 Surface Finish Requirements

Finished surface of lightweight concrete fills shall be tested for smoothness with a 10-foot 3000 millimeter straightedge placed anywhere on the surface in any direction. Entire surface area shall be tested. Surface smoothness shall be plane to the tolerance as specified.

Surfaces sloped to drains shall be tested for slope and smoothness with a template having the required slope. Tolerances shall be the same as specified for plane surfaces.

Final surface shall be of uniform texture and shall be within specified tolerances for smoothness and slope. Low or defective areas shall be immediately corrected by cutting out faulty areas and replacing them with fresh concrete of the same concrete class as required to obtain specified surface requirements. High areas shall be removed by grinding until specified surface requirements are obtained. Other remedial measures may be performed subject to approval.

-- End of Section --